A STUDY OF BLACKBIRD REPEATS AT A DECOY TRAP

HAROLD E. BURTT AND MAURICE L. GILTZ

Department of Psychology, Academic Faculty of Zoology,
The Ohio State University, Columbus, Ohio

ABSTRACT

The tendency for banded birds to "repeat", i.e. re-enter a decoy trap, is greatest for Grackles, followed by Cowbirds, Red-wings, and Starlings in that order. This finding is based on 6477 repeats contributed by 29,479 birds. The species differences are statistically significant ($p<.01$). Analysis of seasonal variables tends to minimize their contaminating effect. From an explanatory standpoint, the comparative stability of the species samples may be an intervening variable, but the basic cause of the inter-specific differences appears to be in the field of what is here called personality.

INTRODUCTION

The practice of banding birds and subsequently recovering a banded bird is usually used only to reveal facets of bird migrations and longevity. However, many birds banded at our decoy trap re-entered the trap one or more times and presented to us the opportunity to study this "repeat" behavior.

The terminology used in the Bird Bander's Manual (Migratory Bird Populations Station, 1963) is followed in this report and accordingly re-entries are designated as "repeats". The present study deals with inter-specific differences in tendency to repeat. It is based on a sample of 29,479 banded birds, which contributed 6477 repeats. The sample is composed of Common Grackles (*Quiscalus quiscula*), Brown-headed Cowbirds (*Molothrus ater*), Red-winged Blackbirds or Red-wings (*Agelaius phoeniceus*), and Starlings (*Sturnus vulgaris*). The trap was operated on the University Farm in Columbus, Ohio, and is described elsewhere (Burtt, 1965; Burtt and Giltz, 1969b).

A term used commonly throughout this discussion is "repeater". This refers to an individual bird that re-enters the trap any number of times, in contrast to the word "repeat" which means any re-entry. Thus if a banded bird re-enters the trap five times, records show one repeater and five repeats.

SPECIES DIFFERENCES IN REPEATING, 1968

The study is based on two samples of banded birds, one in 1965 and the other in 1968. Actually the decoy trap has been in operation since the fall of 1963 (for populations banded in the early years, cf. Burtt and Giltz, 1967b), but the

TABLE 1

Comparisons of Species Repeating in 1968

	Grackle	Cowbird	Red-wing	Starling
1. Number banded	2685	2138	5728	3661
2. Repeaters	490	246	295	49
3. Repeaters/number banded	.18	.12	.05	.01
4. Repeats	2107	619	821	55
5. Repeats/number banded	.78	.29	.14	.01
6. Stability-average day	14.6	3.6	4.2	0.8

systematic recording and analysis of repeats began July 1, 1965. Results for 1968 appear in Table 1. The first line shows the number of birds banded during 1968 for each of the species indicated at the heads of the columns. The second line gives the number of repeaters in the respective species. It may be noted

that the Grackles have the most repeaters, although their banded sample is smaller than that of the Red-wings or the Starlings. The trend may be shown more clearly by taking the ratio of repeaters to number banded (third line). Here the Grackles have proportionately the greatest number of repeaters, followed by the Cowbirds, Red-wings, and Starlings in that order.

To determine whether these species differences are statistically significant, chi-square is applied to the entries in the second line, including, of course, the number of non-repeaters. Chi-square is 746, whereas only 11.3 is required for significance at the 1% level. Thus the species are not drawn from a banded population that is homogeneous with respect to tendency to repeat.

Another aspect of these species differences involves multiple repeating, i.e. re-entering the trap more than once. Actually one Grackle repeated 72 times. The trend is indicated by the total number of repeats for each species, as shown in the fourth line. The Grackles have the most repeats, just as they have the most repeaters. To show the trend more clearly, the fifth line relates the number of repeats to the number banded. The species differences are more pronounced than in the case of the repeaters and the species are ranked in the same order.

As to statistical significance, the totals in the fourth line are based on frequency distributions for one repeat, two repeats, three repeats, etc., and a simple analysis of variance may be made using these distributions. The ratio (F) of the variance between species to the variance within species is 8.8, whereas an F of 3.8 is sufficient for significance at the 1% level. Inasmuch as the above-mentioned distributions do not appear strictly normal, an additional precaution is taken. The frequencies are tabulated for no repeats, one repeat, two repeats, and more-than-two repeats, and chi-square is computed. The analysis stops with the category "more-than-two repeats," rather than going on to three repeats, four repeats, etc., because this latter approach would involve several cells with less than five entries, which is the minimum recommended entry when using this method of analysis. The result is a chi-square of 762, whereas 21.6 is adequate for $p < .01$. Thus the interspecific differences in tendency to repeat are clearly established by the data for both repeaters and repeats.

It might be of interest to relate the data on repeats to the species populations in the area rather than to the banded samples. However, the Lincoln Index (Nunnelley, 1964), which is sometimes used to estimate such populations, is unsatisfactory in the present case. With Starlings the estimated population on July 1 and July 3 is infinitely large, while it is only 42 on July 2. This difficulty stems from the fact that the formula has in its denominator the number of repeats on any given day. If there happen to be no repeats, then dividing the numerator by zero yields infinity. Furthermore a bird must be banded before it can repeat, so that the banded sample is the more logical basis for evaluating the incidence of repeats. Therefore the subsequent discussion will be confined to the banded samples rather than the species populations.

A variable that may be related to the trends in repeating just described is the stability of the banded samples. If most of the banded birds of a given species remain in the vicinity for a considerable time, then the probability of their getting re-trapped is greater. If, on the other hand, each banded bird moves from the vicinity on the next day, it is not available as a repeater. In the former case, the species sample may be termed stable, and in the latter unstable. This stability variable may be quantified by noting how many of the birds that are present on a given day have been in the area for a specified number of days such as ten days. Such a *stability index* has been described elsewhere (Burtt and Giltz, 1969a), using ten days in the above sense, although it could be based on some other period such as five days.

The stability index is determined initially for each day and the average daily index may then be computed for any desired period. In the present case, such a

period includes all the days in 1968 when there was at least some banding activity with reference to the species involved. Actually the numbers of days included in the averages are: Grackle 229, Cowbird 153, Red-wing 245, and Starling 168. These average indices appear in the sixth line of Table 1. A simple analysis of variance yields a ratio of variance between species to variance within species of 75, where 3.8 is required for $p < .01$. Thus the species samples differ significantly in stability, with Grackles and Starlings at the extremes and Cowbirds and Red-wings intermediate. It should be noted that the larger index for Grackles is based on a sample that is smaller than that for Red-wings or Starlings. This relation between repeat data and stability, particularly at the extremes, may imply some causality. On the other hand, the stability may merely be an intervening variable, the cause of which lies in some more fundamental species characteristic. This point will be discussed later.

SPECIES DIFFERENCES IN REPEATING, 1965

The question may arise as to whether the trends found in the 1968 sample characterize the species more generally. A partial answer may be obtained from analysis of data from the 1965 sample for July 1 through December 31. Table 2 gives the 1965 data in exactly the same form as Table 1. The results for repeaters and repeats in the third and fifth lines are strikingly similar in the two tables. A chi-square test applied to the second line in Table 2 yields 384, where only 11.3 is required for $p < .01$. Analysis of variance applied to the frequency distributions basic to the third and fifth lines gives an F ratio of 56, where 3.8 is sufficient for

TABLE 2
Comparisons of Species Repeating in 1965

	Grackle	Cowbird	Red-wing	Starling
1. Number banded	1221	3954	6606	3486
2. Repeaters	213	502	456	101
3. Repeaters/number banded	.17	.13	.07	.03
4. Repeats	960	1051	751	113
5. Repeats/number banded	.79	.27	.11	.03
6. Stability-average day	11.3	1.7	2.0	1.1

$p < .01$. The supplementary consideration of no repeats, one repeat, two repeats, and more-than-two repeats gives a chi-square of 563, whereas 21.6 will give $p < .01$.

The 1965 stability indices show the same trend as do those for 1968 and the species differences are significant. The F ratio is 142, while 3.8 is sufficient for $p < .01$. However, the correspondence between the two years in stability is not as marked as is the correspondence of the repeat data, although the species are ranked in the same order. What emerges from the tables is that Grackles far exceed the other species in tendency to repeat at a decoy trap, followed by Cowbirds, Red-wings, and Starlings in that order, and that the Grackle sample is the most stable and the Starling sample the least stable, with those of Cowbirds and Red-wings intermediate.

CONTAMINATING VARIABLES

Before accepting the foregoing conclusions as final and then attempting to explain them, it is advisable to investigate some possible contaminating variables. Some of these are seasonal. For example, if birds do less repeating during migration and a given species is sampled primarily during the migration season, then that species will appear spuriously low in the repeat figures for the year. A partial check on seasonal variables may be made by noting trends in repeating through

the year. The data are analyzed by months—the number of repeats in a month divided by the number banded in that month. These ratios for 1968 appear on the ordinate of Figure 1 with the months on the abscissa. A few monthly subsamples are omitted because they are so small that their reliability may be questioned. Figure 2 presents similar data for 1965.

Both figures show that, for the most part, the comparative standing of the four species holds throughout the months sampled. The Grackle curve is consistently above the others and the Starling curve consistently at the bottom. The Cowbird and Red-wing curves are not conspicuously separated, but such difference as is apparent favors the Cowbirds, corresponding to the data in Tables 1 and 2.

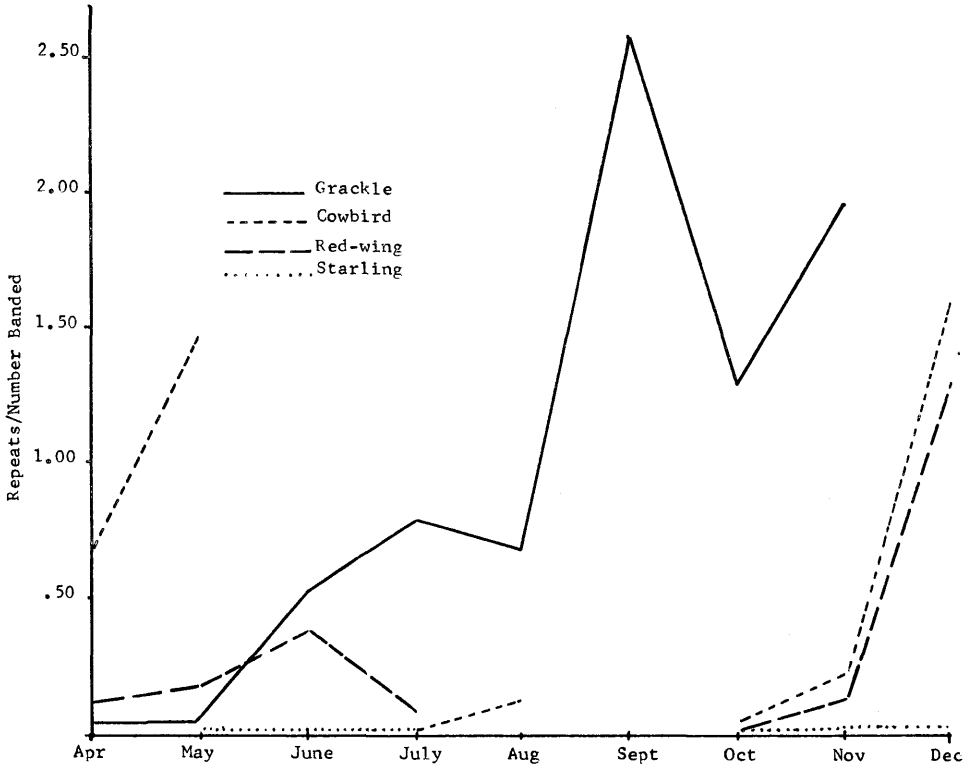

FIGURE 1. Species difference in repeats, 1968.

While the curves show some fluctuations, the important thing in the present context is their discreteness, which tends to minimize possible seasonal bias. At any rate such bias is insufficient to obscure the interspecific differences demonstrated in the present data.

To be still more certain about the seasonal variables, several of them will be considered individually with the 1968 data. The first is the influence of the breeding and nesting season, when the birds may tend to remain near the nesting area. If this area is in proximity to the trap, the birds would be liable to do more repeating. The first line of Table 3 gives data for a breeding season arbitrarily taken as April to July inclusive, and the second line similar data for the remainder of the year. The basic entry is the number of repeats in the period, divided by the number banded in that period. The results are equivocal. The Grackles show less tendency to repeat during the breeding season and the other species show no

appreciable difference between breeding season and the rest of the year. Thus there is no general bias that cuts across species. Moreover the Grackle tendency to do more repeating in the entire year cannot be attributed to a breeding-season bias which points in the opposite direction.

A second seasonal variable stems from the claim of some ornithologists that young birds are more inclined to enter a trap than are adults. Hence in the season when young birds are an appreciable part of the sample, more repeating might be expected. No immature birds have been taken in the present traps before June, so this season is taken as June to August inclusive. Young birds are of course present after August 31, but their behavior is becoming increasingly

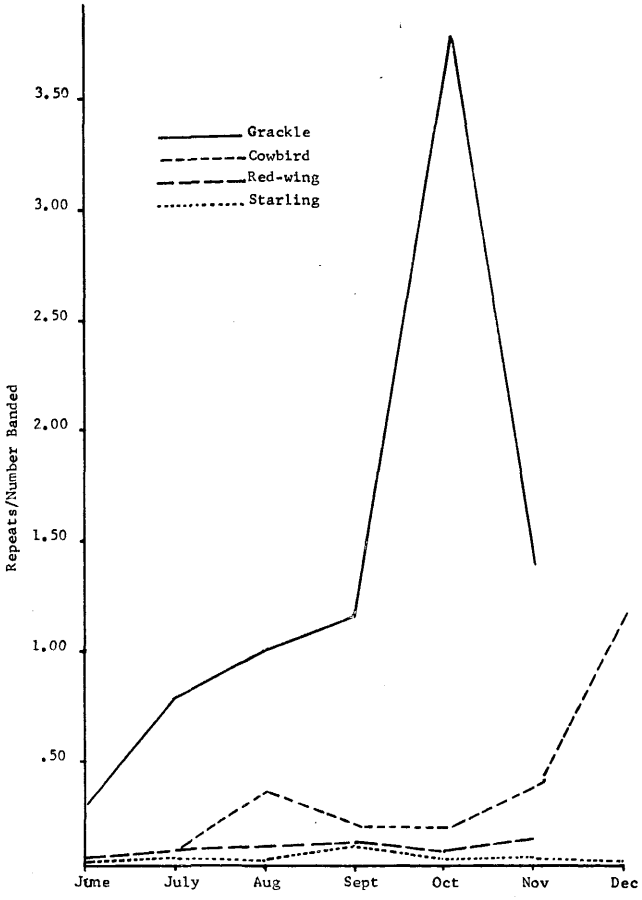

FIGURE 2. Species differences in 1965.

more "adult" as the season advances. Data for the June-August period appear in the second block of Table 3. There is no evidence of increased repeating in this period. In fact, the Grackles and Cowbirds show somewhat the opposite tendency.

A third seasonal variable is migration. One might expect a migrant to enter the trap once and then to move on without repeating. Inadequate data are available for spring migration, but the third block of the table gives results for fall migration, taken as October 16 through November 30. The results are con-

tradictory. Cowbirds and Red-wings do show the hypothesized decrease in repeating, but Grackles show an increase. Thus there is no general bias that cuts across all species.

A fourth seasonal variable involves winter residents. Some birds actually "winter" in the trap (cf. Burtt and Giltz, 1967a). The last block of the table compares December with the rest of the year. The ratio for Grackles is bracketed because only five birds were banded in that month, although there were 97 repeats. Cowbirds also show a greater tendency to repeat in December. While this increased repeating is interesting in its own right, from the standpoint of contaminating variables it cannot seriously bias the annual data, because the samples of birds banded in December constitute only a very small proportion of the samples for the year—Cowbirds 5%, Red-wings 2% and Grackles less than 1%. Thus when these seasonal variables are examined in detail, they do not appear to exercise a consistent bias on the trends shown in Tables 1 and 2.

A possible contaminating variable that is not seasonal is species difference in food preference. The cracked corn used as bait may not attract Starlings as much as it does the other species. Studies of stomachs or crops with the contents

TABLE 3
Seasonal Variables 1968

	Grackle		Cowbird		Red-wing		Starling	
	Number Banded	Repeats/ N Banded	Number Banded	Repeats/ N Banded	Number Banded	Repeats/ N Banded	Number Banded	Repeats/ N Banded
Breeding season	1692	.62	275	.29	2903	.14	1928	.02
Rest of year	993	1.04	1863	.29	2825	.13	1733	.01
Young present	2337	.67	250	.04	539	.13	1894	.02
Rest of year	348	1.49	1888	.32	5189	.14	1767	.01
Fall migration	115	1.63	1703	.21	2257	.09	864	.01
Rest of year	2570	.74	435	.62	3471	.17	2797	.02
Wintering	5	(19.3)	113	1.61	124	.13	701	.01
Rest of year	2680	.74	2025	.21	5604	.11	2960	.01

classified as "plant" or "animal" indicate a comparatively smaller proportion of plant food for Starlings, something on the order of 40% as against 65–75% for the other species (Martin, Zim, and Nelson, 1961). Insofar as these figures reflect food preference, they may partly explain the smaller repeating tendency of the Starlings. Perhaps eating the cracked corn used as bait in the trap provides only a weak reinforcement toward learning to re-enter the trap. However, if the corn is recognized at the outset, one could not expect such a large number of Starlings to enter the trap initially, because Starlings normally eat other foods. Thus it would seem that food preference is not the only variable contributing to the low level of tendency to repeat on the part of the Starlings.

POSSIBLE EXPLANATIONS

Three possible explanations of the inter-specific differences will be discussed: (1) stability of the species sample; (2) modifications of behavior produced by experience in the trap; and (3) personality characteristics.

The concomitance of stability and repeating has been noted above. Grackles especially manifest a marked tendency to repeat and a marked tendency to remain in the vicinity. The last aspect is further corroborated in a study of 958 recoveries of banded blackbirds (Burtt and Giltz, 1969d). With Grackles, 80% of the recoveries are local, i.e. within the city limits of Columbus, whereas with Cowbirds, Red-wings, and Starlings, local recoveries are of the order of 20 to 30%.

It may be pertinent to investigate the relation between repeating and stability directly. The 1968 data are available in two-week intervals. For each interval, the average stability and the total number of repeats are listed and the two variables correlated (rank-difference-squared formula). Similar correlations are computed with the 1965 data grouped by ten-day intervals. The correlation coefficients for Grackles, Cowbirds, and Red-wings are in the sixties and seventies in 1968, but are considerably lower in 1965. Starling coefficients are small and negative in both years. This suggests an appreciable, but not entirely consistent relation between stability and tendency to repeat. However, it is possible that the real cause of species differences in repeating is some more basic aspect of behavior, so that stability is merely an intervening variable. Certainly stability does not account for all the variance in the tendency to repeat.

The second possible explanation, viz. modifications of behavior resulting from trap experiences, ties into the field of learning. It is doubtful if birds learn to *avoid* a decoy trap because negative reinforcement (confinement, fear) does not occur at the moment of entering and thus is not associated with the act of entering (cf. Burtt, 1967, p. 120). On the other hand, it is conceivable that a bird can learn to *re-enter* the trap. At the outset, the bird is positively reinforced (rewarded) with food and possibly companions, and may come to associate the reward with the act of entering and thus learn to re-enter the trap. A stronger reinforcement should promote more effective learning. The possibly weaker reinforcement provided by corn for Starlings was noted above. But the same study of crop and stomach contents for Grackles, Cowbirds, and Red-wings indicates no appreciable difference in plant vs. animal food for these three species. On this basis, with equal reinforcement, these species should learn to re-enter the trap to the same degree, which obviously they do not. Thus it appears that the interspecific differences in tendency to repeat do not lie in the field of learning.

The third possible explanation for the interspecific differences is in the field of what is here called personality. This is an aspect of bird behavior that has received comparatively little attention. At the human level, the importance of personality has been evident for some time, for example its relation to delinquency, school drop-outs, or vocational failure. An employee may have adequate aptitude (intelligence) for the job, but be lazy or overly introverted and thus a failure. It is not a question of what he *can* do, but what he *will* do. Analogous considerations in a bird are not how hard it can bite, but how frequently or readily it will bite; not how fast it can fly, but whether it actually does fly away from an adversary (cf. Burtt, 1967, Chapter 10). Considerations like these are implicit in some of the studies of peck order, where individual differences appear that are suggestive of human differences in personality (cf. Ellis, 1966).

Various aspects of bird behavior, such as aggressiveness, complacency, self sufficiency, prolonged immaturity and even psychotic behavior, have been observed and reported in the literature, although perhaps not designated as manifestations of personality. It is probable that some of these behavior characteristics have been acquired (learned) by the individual bird, while others are genetic and have survival value.

This personality aspect of bird behavior is reviewed briefly elsewhere (Burtt and Giltz, 1969c). This review contained descriptive terminology covering personality characteristics used by careful observers of bird behavior and various studies of aggressiveness as manifest in peck-order situations. The present writers have made two empirical studies in this field. One study developed a rating scale for the aggressiveness of a bird held in the hand and manipulated in a standard fashion (Burtt and Giltz, 1969b). The other placed birds individually in an observation cage and recorded several behavior variables in detail, by use of a tape recorder, to yield a score on a complacency-agitation continuum (Burtt and Giltz, 1969c).

We are still in the very early stages of research on the various aspects of bird

personality. Such research may provide insight into the underlying physiological basis for these kinds of behavior. It may also indicate the comparative importance of genetic and acquired components of avian personality. Conceivably some aspects of personality have survival value, but individual experience may provide some modifications of the genetic pattern as it does at the human level.

As to the actual personality variables related to the interspecific differences in tendency to repeat, one possibility is the complacency-agitation variable just mentioned. Empirically Starlings are at the more agitated end of the continuum. This corresponds to their behavior in the trap—rapid, frequent flight from end to end of the trap. It is possible that, when banded and released, this agitation leads them to leave the vicinity rapidly. Actually when other species are released after banding, they fly only to a nearby bush or tree. Starlings, on the other hand, are last seen as a speck against the sky. Many of them presumably will not return to the trap area at all and thus the chances of their subsequent re-entry are minimized. The writers are disposed to attach more significance to this factor than to the food preference mentioned earlier. In this same personality variable, Cowbirds are empirically the most complacent, although they rank below the Grackles in tendency to repeat.

Another pertinent personality variable is social tendency. The decoys in the trap in the first instance attract the attention of birds flying overhead. However, the decoys are also social stimuli and some outsiders may be inclined to join them, just as birds often join a flock. Species may differ in this inclination. Thus after being banded and released, a bird may go back to join the others in the trap. Conceivably the social experience may serve as a reinforcement for some birds, so that they learn to re-enter, as suggested above. As to the comparative social tendencies of the species involved here, quantitative information is lacking. They all flock to some extent. If one observes behavior in the trap, Cowbirds are conspicuous by the way they sit a few inches apart on the perches provided. However they rank second to the Grackles in tendency to repeat.

While interspecific differences have been established by the data in Tables 1 and 2, obviously a complete explanation of these differences is not available. By a process of elimination, personality characteristics appear to be a major causative factor, but at the moment only a few of these characteristics can be identified. To discover other characteristics that are pertinent in the present context, or involved in bird personality in general, research programs will presumably follow the pattern that is used at the human level. A personality trait may not be a completely unitary type of behavior, but may comprise several components or factors. Psychometric techniques may be developed that will measure both various of the traits and the extent to which they are inter-related. Then a factor analysis of the matrix of intercorrelations will afford a better basis for speculation as to the nature of the factors measured. This approach should ultimately provide considerable insight into the structure of avian personality.

To the writers, the present study confirms the importance of personality as an explanatory principle in bird behavior and points up the need for further research in this field.

SUMMARY

This study analyzes 6477 repeats or re-entries at a decoy trap made by 29,479 banded blackbirds. Grackles show the greatest tendency to repeat, followed by Cowbirds, Red-wings, and Starlings in that order. Samples banded in 1965 and in 1968 agree closely with reference to the inter-specific differences. All the differences are statistically significant ($p < .01$).

Seasonal variables such as breeding or migration apparently do not contaminate the data. They show no consistent bias and the comparative tendency of the species to repeat holds up throughout the year.

A stability index based on the number of birds that have been in the vicinity for at least ten days shows greatest stability for Grackles and least for Starlings, corresponding to their extreme positions in tendency to repeat. Insofar as stability accounts for the major trend, it may well be an intervening variable. However, the basic explanation is believed to lie in personality factors such as complacency, social tendency, and others not yet investigated. Our ultimate body of knowledge about avian personality will stem from further psychometric studies and factor analysis of the future data.

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